KINKS IN THE CONTROL OF HYPOCHLORITE AT DENVER[1]

By W. W. De Berard

Hydraulic mixers of the type used in cyanide plants are employed to dissolve and mix bleach in the four installations which sterilize the water supplied by the Denver Union Water Company. Other novel details of these plants include the graduation of the scales on the solution tanks in pounds of solution and the control of the flow from the constant head box by special long-lever controlled plug cocks.

In the arrangement at Willard where there is a 10,000,000 gallon rapid filter plant, two horizontal solution tanks 12 feet long set 5-foot centers are made out of 48-inch woodstave pipe. Above one end of these tanks is a mixing tank consisting of a 50-gallon barrel with the necessary inlets, outlet pipes connecting the mixing barrel with the solution tanks, water supply and the drain. To agitate the chemical with the water in the mixer barrel, a 1-inch pipe entering at the bottom is reduced to a $\frac{1}{2}$-inch nozzle which extends up into a 2-inch four-way cross. The side outlets of the cross are open. From the top outlet a 2-inch pipe extends above the top of the barrel and terminates in a tee into which are screwed nipples and turned down elbows. The discharge is thus given a downward motion. A branch carries part of the supply through the side of the barrel about 2 inches above the bottom. A 45-degree elbow with a $\frac{1}{4}$-inch nozzle on the inner end of this pipe gives the solution a whirling motion which throws all of the sediment to the center.

In operation enough of the dry chemical is weighed out, to make up a one per cent solution, and dumped into the barrel, which is full of clear water. Filtered water under 75-pound head is then turned on. The jet action of the water entering the tee at the bottom of the barrel pulls water and undissolved chemical into the central pipe, or hydraulic elevator as it is called, and discharges it at the top. The swirling motion of the water entering at the side of the barrel rolls the undissolved chemical constantly toward the center

[1] Read at meeting of Illinois Section, American Water Works Association, March 10, 1915.

where it is drawn into the elevator by the injector action of the water entering through the ½-inch nozzle pipe. Screens prevent lumps from passing to the storage tanks through the 2-inch overflows.

In half an hour practically all of the hypochlorite is discharged from the hydraulic mixer, and the storage tank will be one-half or two-thirds full. The remainder of the clear water to make up the solution to proper strength is brought into the bottom of the

SOLUTION TANKS

tanks midway between the bulkhead ends. Two-foot lengths of pipe terminating in ½-inch nozzles are screwed into a tee on the inlet pipe to give an additional mixing by the swirling motion produced. Numerous tests at the surface, center and bottom of the storage tank after standing 8 hours indicate a variation of less than 0.43 per cent.

SCALES READ IN POUNDS

Solutions of one per cent strength are invariably used. A glass gauge on the end of the tank is graduated to read directly in pounds

of chemical. Readings of the gauge are taken at one-hour intervals, and adjustment made if the necessary quantity is not feeding. By having the scale read in pounds a very simple calculation, as outlined in the *Engineering Record* of July 25, 1908, gives results in grains per gallon, sufficiently accurate for all practical purposes. Pounds used between readings divided by the product of the minutes between readings by the rate of flow of the treated water expressed in million gallons per day gives the grains per gallon applied within one per cent of the correct figure. Following the recent practice of expressing results in pounds per million gallons, the weir scales have been calculated to read in gallons per hour, so that one division gives results at once, the solution tank being read every hour.

Graduation of the scale is accomplished by actually weighing into it 200 pounds of water from a small barrel resting on a scale. Points are marked on the scale board after each addition. Graduations between these intervals are interpolated down to 10 pounds of water which with the one per cent solutions used means 0.1 pound of chemical. A 4 x 4-inch pine stick is grooved to admit the $\frac{1}{2}$-inch glass gauge flush with the outside. The pound marks, about $\frac{1}{2}$-inch apart in the center of the tank, extend across the face of the 4 x 4-inch stick, while the $\frac{1}{10}$-pound marks are on a graduated strip at the back of the glass, an arrangement permitting easy reading.

To obviate the etching of the glass tube by the hypochlorite, clear water is run into the tube as soon as the storage tank is filled, or the gauge cock may be closed during the filling operation so as to exclude the hypochlorite solution at all times. The difference in the reading due to the difference in the specific gravities of the water and the solution is too small to correct.

CONSTANT HEAD CONTROL

Instead of the usual orifice box a simple arrangement used by the company for some time in the feeding of coagulant solution at the Willard plant has been used with slight modifications for the hypochlorite of lime feed. The former coagulant rig consists of a 30-inch vitrified sewer pipe set bell end down and filled in with about 10 inches of concrete to make a bottom. Reliance was placed on the coagulant to insure tightness, but the pipe never leaked. A hole was drilled through the pipe just above the bell for the entrance of a $\frac{3}{4}$-inch brass pipe, which extended horizontally to an upturned ell

in the center of the vitrified pipe. A short piece of pipe was screwed into the ell long enough to rise a few inches above the concrete surface so as not to take in sediment. A constant head supply to this tank was furnished through an ordinary brass hopper ball cock. The outlet was through a plug cock with a lever handle extended by a wire pointer over a graduated board. The graduations were arbitrary as the cock was eaten out in time and gave increased discharges for the same setting. This was of little consequence so long as the cock did not leak, for reliance was placed entirely on reading the gauge on the solution tank for applying the correct amount of coagulant.

In the hypochlorite of lime plants the vitrified pipe was replaced by whiskey barrels. Ordinary ball cocks coated with paraffine or blocks of wood dipped in asphalt are used to keep a constant head and $\frac{3}{4}$-inch steam cocks with extended lever handles control the discharge. A fine adjustment screw with the fulcrum and nut set in tapered holes in a fixed quadrant, and the lever respectively allow the operator to remove the screw, flush the valve and replace the lever at exactly the former position. The plug in the cock is filed away for $\frac{3}{8}$-inch with a $\frac{1}{4}$-inch rat tail file to give a fine stream.

Design and construction of these various devices were carried out under the direction of D. G. Thomas, chief engineer of the Denver Union Water Company.